Editorial

Life Cycle Assessment in Canada

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In Canada LCA is enjoying something of a renaissance. This is being led on two fronts: by government agencies seeking more integrated systems approaches to evaluating and managing environmental issues; and by academics who have found that LCA occupies an intellectual territory rich in theory, methodology, data and application. Both these trends are expected to encourage greater use of life-cycle approaches in industry. Before discussing present day activities, it is worth considering some of the historical highlights in evolution of the tool in Canada, albeit from a personal point of view. Thanks are given to those who contributed; apologies are offered to any individuals, organizations or projects that may have been overlooked.

LCA studies were first initiated by major companies and industrial groups in Canada's resource economy. The aluminum, plastics, wood, steel, other metals and paper industries were also players in the early 1990s, resulting in a number of studies and marketing publications, sometimes as part of broad USA-Canadian efforts. In 1991, Alcan Aluminium Ltd. was part of a jointly conducted LCI on the North American aluminum beverage can. The study established a detailed baseline of environmental performance in aluminum production, can manufacturing, can filling, recycling and disposal. Steven POMPER was a significant force in these early days and subsequently contributing landmark SETAC work in the area. Canadian polymer manufacturers, through the industry's Environment and Plastics Industry Council, contributed significantly to the 1991 North American LCI of the seven commodity resins, Scott CHUBBS from Dofasco steel company contributed to efforts in that industry in Canada and across North America, and is now General Manager, Sustainability at the International Iron and Steel Institute. In 1995, the Canada Wood Council published *Environmental Effects of Building Materials*, and continues today to be active in life-cycle, greenhouse gas and sustainable buildings materials considerations. Also concerning the forest sector was a study of the production of a daily newspaper and a weekly magazine was completed in 1998 by an international group of companies Canfor Corporation, a major forest, wood and pulp firm (www.canfor.com/resources/4000/lca.pdf and www.temap.com//temap/pubs.html). The company has continued to use life-cycle approaches in greenhouse gas and other studies.

At universities, Martin HOCKING at University of British Columbia (Hocking 1991) sparked public interest in the field. Some of the first concerted effort was initiated in the early 1990's at University of Toronto by Steven B. YOUNG on his PhD studies (Young & Vanderburg 1994, Young 1996).

In light of studies in the private sector, and given a policy interest in LCA, on packaging and solid waste, standardization efforts were initiated by the Canadian Standards Association about. Following a couple years of expert meetings, in 1994 the first environmental management standard on LCA was published, *Z760 Life Cycle Assessment*, under the oversight of Ahmad HUSSEINI. Subsequent documents included *Z810 Life Cycle Impact Assessment: Pulp and Paper Production Phase*, and the streamlined LCA method guide *PLUS 1115: Life Cycle Review*. Canadian experts went on to play strong roles in the ISO 14040 series development.

The Canadian federal government's earliest contributions to LCA were associated with packaging and solid waste considerations of the early 1990's. The Canadian Council of Ministers of the Environment released *Environmental Profiles: Guidelines to Help Industry Meet the Goals of the National Packaging Protocol* and *Sources of Data for the Life-cycle Analyses of Canadian Packaging Products* on the life-cycle stages of commonly used packaging materials. Environment Canada supported LCA capacity and education with a number of documents, several workshops, and the *Ecocycle* newsletter published from 1995–2000 (www.ec.gc.ca/ecocycle). Studies included *Environmental Life Cycle Management: A Guide for Better Business Decisions* (www.ec.gc.ca/ecocycle/en/publications.cfm) and the 1997 publication *Life Cycle Management in Canada*, which reviewed activities at 37 firms across Canada, and concluded that businesses were experimenting with the tool, using LCA as a business and marketing approach, and to complement their Environmental Management Systems.

As for manufacturing industries, some work has been executed in the automotive parts sector, which is an important part of the Canadian economy. Electric power, chemicals, packaging, and plastics sectors also saw some application of LCA in the 1990s. Reflecting another dimension of Canada's economy, a large high-profile LCA study of a business telephone was completed in 1997 by Nortel Networks; results are summarized at www.ec.gc.ca/ecocycle/issue7/en/p6.cfm.

By about 1999, solid waste and packaging stewardship concerns were no longer at the top of the federal government's environmental agenda. In the same period, many private company efforts involving LCA had petered out. A number of reasons are cited for this: LCA is inconclusive, too expensive and time-consuming – and cannot be effectively utilized for competitive marketing efforts. As a consequence, other tools like EMS, performance indicators, environmental/social reporting, and environmental labeling came of greater interest to industry in their efforts in business sustainability. For product analysis, focus on environmental issues developed, including more specific consideration of embodied energy, greenhouse gases, presence of toxic substances, and recyclability/recycled content.

Today

There are a number of groups that have helped carry LCA in Canada into the new millennium. Jamie MEIL and Wayne TRUSTY manage the Athena Sustainable Materials Institute (www.athenasmi.ca), a not-for-profit organization that traces its origins to 1991 and provides LCA services and database and impact assessment tools that address the environmental impact of buildings and building products. Today Athena is a co-leading the U.S.A. (North American!) life-cycle inventory database project, and has recently announced its latest version of software for the life-cycle assessment of buildings. Athena provides a platform for LCA in the architectural, building and construction arena; its members include cement industry organizations, natural gas companies, and various government agencies.

The non-profit Pembina Institute for Appropriate Development (www.pembina.org) working primarily in the oil & gas energy sector, has developed their own Life Cycle Value Assessment methodology, and has recently published the influential Life-Cycle Value Assessment (LCVA) of Fuel Supply Options for Fuel Cell Vehicles in Canada. Their Corporate Eco-Solutions Program is led by Marlo RAYNOLDS, a long-time expert in fuel-cycle analyses, project and site specific life-cycle studies that apply LCA approaches.

CIRAIG (www.polymtl.ca/ciraig) is a substantial and exciting academic initiative that jumped into the life-cycle approaches scene in 2001. Directed by Réjean SAMSON, the interuniversity reference center generates integrates and interprets relevant knowledge in the fields of LCA and life cycle management. With a large team involving more than 30 researchers, and a comprehensive toolbox of data and software, the center supports industries and government from Quebec institutions including École Polytechnique de Montréal, the Université de Montréal and the École des Hautes Études Commerciales Montreal.

The Faculty of Environmental Studies at University of Waterloo has recently developed an Environment and Business teaching program which is expected to develop research capacity soon. Murray HAIGHT focuses on integrated waste management and composting; Steven YOUNG specializes in issues of materials stewardship and resource efficiency. Waterloo hosts two large projects. One is the Integrated Waste Management Model (www.iwm-model.uwaterloo.ca/), a desktop LCA tool for the evaluation of life cycle environmental and economic effects of waste management systems commissioned by Corporations Supporting Recycling and Environment and Plastics Industry Council. 2002 marked the release of the long-awaited Canadian Raw Materials Database, also hosted by University of Waterloo (crmd.uwaterloo.ca), a voluntary project involving a cross-section of Canadian materials industries to develop a database profiling environmental inputs and outputs associated with the production of Canadian commodity materials.

Other universities involved in LCA teaching or research include Dalhousie University in Halifax, Carleton in Ottawa and Université Laval. The engineering group at Memorial University in Newfoundland, with Faisal I KHAN, has completed LCA studies related wind-fuel renewable energy utilization, offshore oil and gas operation, and has developed a new indexing procedure for speedy application of risk based LCA decision making (www.engr.mun.ca/~fkhan). Heather MACLEAN's research group at the University of Toronto is using LCA and economic evaluation methods to evaluate the feasibility of alternative fuels and propulsion systems for powering the Canada/U.S. light-duty vehicle fleets (MacLean and Lave 2003). Her research group has also constructed the first economic input-output LCA model for Canada (Bjorn and MacLean 2003). Dixon THOMPSON at University of Calgary has recently published a reference book on tools for environmental management that includes a chapter on LCA (Thompson 2002).

In the Federal government, Albert CHAN (see also Chan 2003) oversees LCA research in the context of sustainability analysis at the National Research Council of Canada and Alain DUBREUIL (see also Dubreuil 2001a,b) runs a program at Natural Resources Canada from at the Mining and Mineral Sciences Laboratories. Dubreuil also coordinates LCA across other federal departments and participates in the UNEP/SETAC initiative. His website at www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/lifecycle/default.htm focuses on LCA of metals. The significance of this sector is reflected also by the Canadian metals industry's continued participation in LCA activities. In addition to aluminum and steel, other companies producing metals use LCA, like Noranda, QIT and Inco (Middleton et al. 2000). One study with significant Canadian content was the international Nickel Development Institute's life cycle study (www.nidi.org/index.cfm/ci_id/114.htm).

Canadian experts in universities, NGOs and government - and users of the approach in industry – are opening new avenues in LCA method and application. The first Canadian forum on LCA in November 2003 hosted by CIRAIG will highlight methodological advances and core capacities in established areas like forestry, waste management, metals and buildings – but will also allow for discussion into emerging areas like agri-food, fisheries, greenhouse gas mitigation, social impacts, and environmental technology evaluation. We welcome the renewed interest and growth of LCA in Canada.

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